Editorial

ecoinvent Data v1.1 (2004)

From heterogenous databases to unified and transparent LCI data

Rolf Frischknecht (ecoinvent project manager)

Swiss Centre for Life Cycle Inventories, c/o EMPA, Überlandstrasse 129, CH-8600 Dübendorf, Switzerland (frischknecht@ecoinvent.ch)

DOI: http://dx.doi.org/10.1065/lca2005.01.001

Lack of reliable inventory data is one of the most cited bottlenecks of LCA studies. Investigation of data for background processes like energy production or transport services is often very time-consuming. With the ecoinvent database, LCA practitioners have now access to a vast, thorough, up to date and unified source of inventory data which covers large parts of the economy. This issue is dedicated to the ecoinvent database and give first insights on its methodology and results of its data version 1.1.

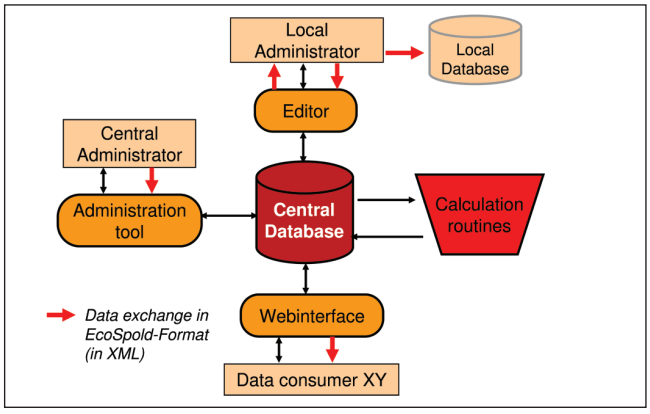

Fig. 1: ecoinvent database system

The ecoinvent database is the product of a long-term project and roots on the vast LCI experiences in Switzerland: Besides the LCI reference works on packaging materials performed by Swiss Federal Laboratories for Materials Testing and Research (EMPA) and the Swiss Federal Institute of Technology Zurich (ETHZ) in the eighties and nineties, the LCI reference work and LCA database 'ecoinvent' on energy systems (and materials, transports and waste management) developed, compiled and published in the mid nineties by the ESU group at ETHZ in growing co-operation with the Paul Scherrer Institute (PSI) in Villigen, got international recognition. The LCI datasets of this first ecoinvent database were published in a fully transparent way. This was one of the reasons why they were implemented (either completely or major excerpts) in databases of several LCA software tools.

However, the various Swiss LCA databases available in the mid nineties were not readily compatible due to methodological and reporting differences. Not surprising that first ideas for a harmonised Swiss national LCI database root back in in that period, namely in 1997. At that time, Konrad Hungerbühler, who was then responsible for the ecoinvent database at the ETHZ, approached Swiss Federal Offices with the idea of bringing together Swiss LCI competences so as to create a national LCI database. From the first moment, he got support from Swiss Federal Offices. After intensive discussions, the pilot project started one year later, in June 1998, with the goal stated in the project description:

> The aim of the project ecoinvent 2000 is to establish a common, future oriented life cycle inventory database for the whole ETH domain[1]. The focus is therefore on a well-structured data warehouse for about 5'000 processes, a user-friendly interface to the database and a common data exchange format. In a second step, a harmonisation of the data shall be established in order to get a consistent backbone of data for the ETH domain.

Besides the ETHZ and the EMPA, which supported the idea from the very beginning, the LCI groups at the Swiss Federal Institute of Technology Lausanne (EPFL), the PSI and the Swiss Federal Institute for Environmental Science and Technology (EAWAG) founded the ecoinvent Centre, the Swiss Centre for Life Cycle Inventories. They participated in this pilot study commissioned by the Swiss Agency for the Environment, Forests and Landscape (SAEFL). René Kilcher, scope information systems, was in charge of the IT-related work for the system specifications and I was mandated as project leader. A working group of the involved institutes from the ETH domain and an external challenger (Rolf Bretz, Ciba Specialty Chemicals) contributed to the design development and definition of the user specifications of the new database. The system specifications that were the basis for programming the actual ecoinvent database system have been elaborated during this pilot project.

After thorough planning of the future structure of the LCI data investigations, of the organisation of the ecoinvent Centre, and of the further project funding, the main project phase 'ecoinvent 2000' started in late 2000. At the same time, the Swiss Federal Research Station for Agroecology and Agriculture (Agroscope FAL Reckenholz) joined the ecoinvent Centre. The Swiss Federal Roads Authority, the Swiss Federal Offices for Construction and Logistics, for Energy and for Agriculture and the SAEFL funded data investigation while the institutes of the ecoinvent Centre funded the project management and the programming of the ecoinvent database system by ifu Hamburg GmbH. In summer 2002, the ecoinvent database software system was ready

[1] Institutes of the ETH domain: Swiss Federal Institute of Technology Zurich (ETHZ), Swiss Federal Institute of Technology Lausanne (EPFL), Paul Scherrer Institute (PSI), Swiss Federal Laboratories for Materials Testing and Research (EMPA), the Swiss Federal Institute for Environmental Science and Technology (EAWAG), and the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL).

and a first test database was published on the internet. One year later, the first version of ecoinvent data was published and in August 2004 an extended and corrected version, ecoinvent data v1.1, was completed.

The current version 1.1 of ecoinvent data contains more than 2700 datasets including the areas of energy, building materials, metals, chemicals, paper and board, forestry, agriculture, detergents, transport and waste treatment services. Data are based on the production and supply situation in the year 2000 and are valid for Western European and Swiss conditions. Furthermore, several actual and widespread impact assessment methods, namely the cumulative energy demand, climate change (according to IPCC 2001), CML 2001, Eco-indicator 99, the ecological scarcity method (UBP) 1997, EDIP 1997, EPS 2000, and Impact 2002+ are implemented in ecoinvent data v1.1. The ecoinvent data are implemented in the LCA software tools SimaPro, Umberto, GaBi, PEMS, Emis, and Regis. The suppliers of CMLCA, KCL-eco and Team provide an ecoinvent interface that allows an easy import of ecoinvent data.

The ecoinvent Centre, hosted by EMPA, will further maintain, update and extend the ecoinvent database. Extensions and further developments may include datasets in additional economic sectors (such as information technology), datasets that are valid for other economies (such as North America or Asia), the implementation of additional impact assessment methods or improvements in the existing database system (such as immediate online access to impact assessment results).

The ecoinvent Centre plans to intensify formal and informal relations to the working group 'databases' of COST action 530, to the UNEP-SETAC life cycle initiative, to the German LCI network, to the USA LCI database and other national and international initiatives. It welcomes and actively participates in discussions towards the harmonisation and possibly standardisation of an LCI data exchange format.

The present issue of Int J LCA includes several papers that present selected aspects of the ecoinvent database and its underlying methodology. The contents are divided into four sections: Introduction, Energy Supply, Materials and Agriculture, and Services. In the Introduction, Frischknecht et al. (2004) give an overview on the ecoinvent database, its contents and selected aspects of the underlying methodology. Within the theme 'Energy Supply' Dones et al. (2004) present the modelling of non renewable energy systems (using the examples of nuclear power and natural gas) and the way how uncertainty has been addressed in the ecoinvent database. The life cycle inventories of photovoltaic electricity and of wind power production are described by Jungbluth et al. (2004) with a special focus on the treatment of multi-output processes and allocation within the ecoinvent database. The Theme 'Materials and Agriculture' includes five papers on building materials, metals, wood and packaging materials, chemicals and arable crops. These papers concentrate on the way how and why the means of production and the infrastructure have been modelled separately from operation (building materials, Althaus et al. 2004), how metal resource consumption of joint resources in mines where several metals are extracted jointly is modelled (metals, Althaus & Classen 2004), how the production chain of wood and especially the diverse by-products along the value added chain are modelled (wood and packaging materials, Hischier et al. 2004a), how the highly diverse information availability of material and energy flows in chemicals manufacturing processes is balanced with the help of standardised assumptions and procedures (chemicals, Hischier et al. 2004b), and how the inputs and outputs of agricultural processes are determined based on model crops and models for field emissions (arable crops, Nemecek & Erzinger 2004). The theme 'Services' contains two papers on life cycle inventories of transport services (Spielmann & Scholz 2004), where the modular structure of the transport service life cycles and its combinations are highlighted, and of waste treatment services (Doka & Hischier 2004), where the modelling of landfilling (including the emission behaviour in the far future) and the assessement of long-term emissions are described.

It is not possible to document all facets of the contents and methodology of the ecoinvent database within one issue of this journal. The papers published in this issue try to highlight selected methodological issues illustrated with the help of LCI examples of most of the economic sectors covered so far by ecoinvent Data v1.1.

I would like to express our thanks to the Editors for the opportunity to present the ecoinvent database in this jubilee issue of Int J LCA. At the same time I wish to congratulate them for their first ten years of support of and contribution to scientific communication, discussion and consensus finding in LCA. I wish the journal a long life (especially a long 'use phase') and a steadily growing and sustainable impact on the scientific development of life cycle thinking tools and on the reduction of society's environmental impacts.

References

Althaus H-J, Classen M (2005): Life Cycle Inventories of Metals and Methodological Aspects of Inventorying Material Resources in ecoinvent. Int J LCA 10 (1) 43–49

Althaus H-J, Kellenberger D, Doka G, Künniger T (2005): Manufacturing and Disposal of Building Materials and Inventorying Infrastructure in ecoinvent. Int J LCA 10 (1) 35–42

Doka G, Hischier R (2005): Waste Treatment and Assessment of Long-Term Emissions. Int J LCA 10 (1) 77–84

Dones R, Heck T, Faist Emmenegger M, Jungbluth N (2005): Life Cycle Inventories for the Nuclear and Natural Gas Energy Systems, and Examples of Uncertainty Analysis. Int J LCA 10 (1) 10–23

Frischknecht R, Jungbluth N, Althaus H-J, Doka G, Dones R, Heck T, Hellweg S, Hischier R, Nemecek T, Rebitzer G, Spielmann M (2005): The ecoinvent Database: Overview and Methodological Framework. Int J LCA 10 (1) 3–9

Hischier R, Althaus H-J, Werner F (2005a): Developments in Wood and Packaging Materials Life Cycle Inventories in ecoinvent. Int J LCA 10 (1) 50–58

Hischier R, Hellweg S, Capello C, Primas A (2005b): Establishing Life Cycle Inventories of Chemicals Based on Differing Data Availability. Int J LCA 10 (1) 59–67

Jungbluth N, Bauer C, Dones R, Frischknecht R (2005): Life Cycle Assessment for Emerging Technologies: Case Studies for Photovoltaic and Wind Power. Int J LCA 10 (1) 24–34

Nemecek T, Erzinger S (2005): Modelling Representative Life Cycle Inventories for Swiss Arable Crops. Int J LCA 10 (1) 68–76

Spielmann M, Scholz RW (2005): Life Cycle Inventories of Transport Services: Background Data for Freight Transport. Int J LCA 10 (1) 85–94